# Corpuscular description of chirped photonic crystal modes

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Chirped photonic crystals are non-periodic optical structures which can be viewed as ordinary photonic crystals perturbed by a slowly-varying spatial modulation of the refractive index distribution. Such structures can be prepared with a gradual modification of the crystal periodic geometry or a gradual change of the refractive indexes. It is shown that, in such a perturbed system, the modes fields can be described as Bloch waves modified by a scalar envelope which adapts to the long-range dielectric function perturbation.

This envelope function obeys a simple linear Schrödinger equation of classical (non-quantum) origin. Close to a band extremum, at a gap edge, the envelope functions can be interpreted as wave functions of particles possessing a finite, spatially-variable, mass. These effective energy carriers come as two species, referred to as “effective photons” (for positive band curvatures) or “photonic holes” (for negative band curvatures). The energy transfer through the chirped structure can be viewed as resulting from the migration of these particles under forces controlled by the long-range dielectric function modulation. Due to the long-range, slowly-varying character of these forces, these particles are stable and are not destroyed by interband transitions.

All-optical effects in one-dimensional chirped photonic structures are investigated using the concept of photonic energy carriers: we reformulate optical shallow donor and acceptor bound states formation, optical Bloch oscillations, optical Zener and optical Frank-Keldysh effects in the framework of this corpuscular picture.